Synthesizing information through a dinosaur toy: An integrative assignment that is scalable for a variety of learners

Andrew B. Heckert (ABH)
Pedagogical/Philosophical Course Goals

• …describe the history of dinosaur knowledge, from prescientific mythological explanations to the current synthesis

• …articulate an understanding and appreciation of fundamental principles of geological and biological sciences as applied to dinosaur paleontology.

• …acquire a basic understanding of paleontological and evolutionary principles.

• …demonstrate proficiency in acquiring, interpreting, and disseminating dinosaur knowledge.

• …incorporate scientific, especially geological perspective into the educational experience at ASU.
Paleontology as a Gateway Science

Pragmatic Course Goals

• Get 250–300 credit hours/Offering w/out lab.
• Maintain standards w/out reading 80+ papers.
• Encourage students to take GLY courses for science requirement.
• Pick up a few majors and minors.
• Make the administration happy, especially those in charge of general education.
• Force a few more folks to face the “e” word, deep time, and other scientific concepts.
• Geology course, but non-science theme
• Counts toward general education, GLY minor
• 3 credit hours, no lab
  – either MWF 50 minutes; TR 75 min.
• Fall 2015, TR, n = 57; Fall 2016 MWF n = 78
• Use ASULearn (Moodle) course software
• Textbook is Holtz & Rey (2007)
  – Cheap, but “free” (rental)
GLY 1842—Nuts-and-bolts

- **Course grade based on**
  - 8% Participation (mostly clickers)
  - 5% Weekly (more or less) “prequizzes” on ASULearn
  - 8% ASULearn exam 1 (date info)*
  - 8% ASULearn exam 2 (date info)*
  - 8% ASULearn exam 3 (date info)*
  - 8% ASULearn exam 4 (date info)*
  - 9% In-class exam (date info)*
  - 11% In-class exam 2 (date info)*
  - **20% Dinosaur projects (See below; due dates TBA)**
  - 15% Final exam (date info)*
  - Total: 100%

- *Exam dates are immutable—see http://www.registrar.appstate.edu/calendar/fallexampolicy.html*
**Instructions:** Choose (obtain) a non-avian dinosaur toy of your choosing, albeit with the following caveats:

1. It is of a recognizable dinosaur*
2. It is a children’s toy or a scale model of an entire dinosaur (not just a skull); and
3. It has been mass-produced (your review will benefit other purchasers)

*I might accept a non-dinosaurian toy (e.g., a pterosaur), but any non-dinosaur has to be cleared with me first.*
Document and review the toy. This includes labeled pictures of the toy in at least three views, an indication of its size and scale, its classification (Linnaean and cladistic), and an understanding of the “Who, what, when, where, why/how” of the dinosaur. Provide some indication of the strengths and weaknesses of the toy.
Dinosaur Toy Review

This is where information regarding the "dinosaur toy review" assignment will be posted.

Final Dinosaur Toy Upload Site

This is the place to upload your final dinosaur toy review project. Do not be late. Late submissions will be penalized enough that you were better off turning it in on time but incomplete.

Dinosaur Toy Selection Upload

Please upload your first dinosaur toy ppt here. This should include a title slide with your name and the name of the dinosaur as well as a slide(s) with a few pictures. Please see "ABHDinoToySelectionMockup" for details.

Please save your file as LastnameDinosaurToy, where "Last Name" is your last name, and dinosaur is the subject of your project. Thus, if ABH did Triceratops, it would be HeckertTriceratopsToy.

ABH Mockup & Instructions for Dinosaur Toy Selection

Dinosaur Toy Review Assignment Sheet

Timescale for your dinosaurs

Calculating the scale of your dinosaur toy

Example of scale calculations w/Coelophysis

ABH Mock-up Coelophysis

Fun clip of an expert reviewing dinosaur toys

Add an activity or resource
GLY 1842—Toy choice mock-up

• IU Field Camp Philosophy: Practice everything
• Dinosaur toy selection is a brief assignment
  – “Low stakes”
• Text in green is an aside for this presentation
• “ABH” in corner means my slide
• “student slide” means an actual submitted slide (used w/permission).
“Mock-up”/template

• This is ABH’s “template” for the assignment
• This is a minimum—I encourage you to be creative and expand on it and make it yours, I just wanted to provide examples – So feel free to pick your background colors, fonts, artwork, etc.
• Slides with “Don’t” on them mean “Don’t do this” as in they are bad examples.
Some Do’s and Don’ts

• **DO italicize** your genus name (e.g., *Coelophysis*)
  – And species, too! E.g., *C. bauri*

• **DON’T italicize** any other taxonomic name (Theropoda, Dinosauria)

• **DO** document your sources

• **DO** use Google Scholar® (scholar.google.com)

• **DON’T** just rely on the Wikipedia

• **DON’T** include slides like this one and the previous
Coelophysis: a review of the toy by Geoworld® (2012)
Dacentrurus armartus
Coelophysis in left lateral view
Coelophysis in dorsal view

Coelophysis in anterior view

ABH
A bad shot (no scale; busy background; not even super-clear focus)
So the toy selection slide

• **Should have a title**
• **Should italicize** your genus name (e.g., *Coelophysis*)
  – And species, too! E.g., *C. bauri*
• **Should** have slides with multiple (labeled) views of your toy
• **Should** be named *YourlastnameGenusToy*
• **Should not** have instructions slides
Time to grade!

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The grader’s most important question

FYI—The other arm says “it’s on the syllabus.”
Rubric set up in ASULearn

<table>
<thead>
<tr>
<th>Grade:</th>
<th>Rubric for the &quot;Dinosaur Toy Assignment&quot; upload of the title slide plus three views of the specimen.</th>
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</table>
| **Title Slide** | Format (Name, toy name, italics, photo, fall)  
0 points | 1/5 1 points | 2/5 2 points | 3/5 3 points | 4/5 4 points | 5/5 5 points |
| **Specimen photos** | 3+ views, each labeled, scale present  
0 points | 1/6 1 points | 2/6 2 points | 3/6 3 points | 4/6 4 points | 5/6 5 points | 6/7 6 points | 7/7 7 points | Some scales missing; "left lateral" view is oblique |
| **File name correct** | Nope  
0 points | Close  
1 points | Nailed it  
2 points |
| **Instructions Slides deleted** | Didn’t delete anything/reused Heckert’s template  
0 points | Extraneous slides present  
1 points | Only slides needed  
2 points |
| **Apparent Effort/Aesthetics** | None  
0 points | Minimal  
1 points | Meh  
2 points | Decent  
3 points | Extra effort apparent  
4 points |
Thus, if I disapprove of a “dinosaur” choice I can make comments here.
ABH’s “mock-up”

• **Pros:**
  – Provides fairly unambiguous examples
  – Educates students about *Coelophysis*
  – Forces them to learn presentation software

• **Cons**
  – A little too “plug & chug”/“plug & play”
  – Does not evaluate writing *per se*
  – References—what to do?
  – Rubric hurts grade flexibility

• **Notes**
  – I repeat the initial slides (instructions, title, views) in the mock-up, but we’re skipping to the good stuff
# Table of Contents

- Title slide w/toy & manufacturer, name, date
- Slides with toy in multiple views
- Specifications (scale & measurements)
- Timescale slide
- Skeleton slide
- Reconstruction slide
- Paleogeographic map
- Cladogram slides (general; detailed)
- Linnaean classification slide
- Pros & Cons slide
- Summary slide
- References slide
Grading first few slides

Mostly “free” points to help build a reserve if they lose “ticky-tack” points later
The *Coelophysis* model is approximately 12:1 scale (2.7 m real life/0.22 m model) = 12.3
Length measurement from Holtz & Rey (2008); according to this model, a full-sized
*Coelophysis* would thus be 2.7 m long, 1.5 m tall, and 0.4 m wide across the hips.
Specs

Scale = 12.272727272727273

Problems:
(1) No details/explanation
(2) Silly number
(3) No citation
Coelophysis is one of the older names given to a dinosaur, it was named by E.D. Cope in 1887.


***Just so you know, Coelophysis has a complex history. Cope referred his new species to Marsh’s genus Coelurus in 1887, but in 1889 published (correctly) that they belonged in a different genus, so the species was named in 1887 even if the genus wasn’t assigned until later.

And it gets more complicated from there.

Most popular dinosaurs were named in articles now linked from the Wikipedia or otherwise easily available
Naming Diplodocus

- The first skeleton was found in 1877 and was named Diplodocus longus ('long double-beam'), by paleontologist O. Charles Marsh in 1878.
- It was named along with other members of the Sauropod suborder.
- The most well know Diplodocus species are D. carnegii, D. hallorum, and D. longus.

*excerpts pages 412 & 414 from Marsh’s “Principal characters of American Jurassic dinosaurs.”
Grading the next few

<table>
<thead>
<tr>
<th>Specimen Photos</th>
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<td>3+ views, labeled, scale present, clean backgrounds</td>
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<th>5/5</th>
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<td>Shot w/a good scale, scale stated, math looks reasonable/no silly numbers, cites a source for size; reasonable calculations of &quot;real size&quot;</td>
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<td>2 points</td>
<td>3 points</td>
<td>4 points</td>
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<th>3/3</th>
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<td>Correct attribution of name; screen shot of title slide; reasonable explanation</td>
<td>1 points</td>
<td>2 points</td>
<td>3 points</td>
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</table>
When did *Coelophysis* live?

**Relative age:** Late Triassic (Rhaetian)

**Numerical age:** Approximately 202-206 Ma

*Coelophysis* is known from the latest Triassic. This is generally considered the Rhaetian and is approximately 205 million years ago.

Timescale from Geological Society of America (GSA, 2012)
Where did *Coelophysis* live?

*Coelophysis* is from New Mexico, which was near the west coast of equatorial Pangea during the Triassic, when all the continents were welded together.
The paleogeographic distribution of *T. rex* is the Interior Western United States and parts of Canada. Locations where *T. rex* fossils have been found are: Colorado, New Mexico, Texas, Montana, Wyoming, South Dakota and Alberta.

*T. Rex* fossils are most commonly found in the Western United States. The most famous *T. rex* fossil was found in South Dakota (Sue).

The red dots indicate locations where *Tyrannosaurus rex* fossils have been discovered.

Locations provided by Sampson (2005) and Holtz & Rey (2007)
Maps Scotese (2014)
Because of the many skeletons of *Coelophysis* from Ghost Ranch, essentially the entire skeleton is known.

Reconstruction of the skeleton of *Coelophysis* by Matt Celeskey (in Rinehart et al., 2009)
What is known of *Dakotaraptor*?

Reconstruction of the skeleton
(from DePalma et al., 2015)

Figure 15. Skeletal reconstruction of *Dakotaraptor* holotype (PBMNH.P.10.113.T) based on available material for *Utahraptor*, *Dromaeosaurus*, *Deinonychus*, and *Achillobator*, demonstrating overall proportions and the large size of the creature. Preserved elements shown in insert.
Skeleton of *Spinosaurus*

- Stromer used *Allosaurus* and *Tyrannosaurus* as models to the missing parts. Many older drawings and models ended up looking like *Tyrannosaurus* with a sail (Holtz 94).

Looking at this reconstruction, you need to know:
- Red/rust-orange = neotype (specimen chosen as ‘new holotype’ when an original is destroyed) and Stromer’s fossils
- Yellow = referred isolated remains (may not be proportional in scaling - basically place “fillers”)
- Green = based on other spinosaurids (not from *Spinosaurus*)
- Blue = reconstructed (based on what we know - not actual fossils)
<table>
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<th>Time scale slide</th>
<th>Star on time scale is correct; relative age; numerical age 0 points</th>
<th>1/3 1 points</th>
<th>2/3 2 points</th>
<th>3/3 3 points</th>
<th>Note &quot;Triassic&quot; typo</th>
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<td>3/3 3 points</td>
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<tr>
<td>Skeletal Reconstruction slide</td>
<td>Skeletal reconstruction; reasonable effort to demonstrate what is known; cites reconstruction 0 points</td>
<td>1/3 1 points</td>
<td>2/3 2 points</td>
<td>3/3 3 points</td>
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</table>
Coelophysis is a coelophysoid theropod (circled).
This is a relatively primitive group of theropods, which are saurischian dinosaurs.

This figure is from their textbook
*Coelophysis* in the theropod family tree

*Coelophysis* is one of the more derived coelophysoid theropods (circled). This is a relatively primitive group of theropods.

In the future I may ask them to tell me who their dinosaur is most closely related to, sister taxon, more “primitive,” more derived, etc.

(From Tykoski & Rowe, 2004)
Coelophysis cladogram

Problems:
(1) Crummy picture
(2) No citation
(3) No explanation
(4) WTH is Coelophysis on this?

FIGURE 3.12. Phylogenetic hypotheses of ceratosaurian relationships: A, Adams consensus of five equally most parsimonious trees generated by our analysis; tree length = 386, CI = 0.588, RI = 0.739. Stem-defined clades indicated by arcs. Node-defined clades indicated by open circles at nodes. B, alternative phylogenetic hypothesis supported by Sampson et al. (2001). C, alternative hypothesis of ceratosaur relationships from Rauhut (1998) and Carrano and Sampson (1999). 1 = Abelisauridae; 2 = Abelisaurinae; 3 = Carnotaurinae; 4 = Ceratosauria.
Linnaean Taxonomy of *Coelophysis*

- **Kingdom:** Animalia
  - **Phylum:** Chordata
    - **Class:** Reptilia
      - **Order:** Theropoda
        » **Family:** Coelophysidae
          - **Genus:** *Coelophysis*
            - **Species:** *Coelophysis bauri* (Cope)

Taxonomy follows Holtz (2002)
Life reconstruction of *Coelophysis*

Reconstruction of a *Coelophysis* flock by Matt Celeskey

From Triassic New Mexico (Lucas, 2008).
<table>
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<td><strong>Life Reconstruction Slide</strong></td>
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<td>Has been on display since 1915, but that hall was recently...</td>
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Pros: Posture

This is a generally “modern” dinosaur reconstruction

- Upright posture
- No tail-dragging
- Nothing obviously wrong
Pros:

Highlights of the toy include the hands (which did have four “fingers” because *Coelophysis* is a primitive theropod) and the base, which actually includes low-tech “tracks.”
Cons: Accuracy

Reconstruction of the skeleton of *Coelophysis* by Matt Celeskey made transparent and overlaying the toy. The middle toe is probably not long enough.

This shows that the toy is much larger and more robust than the skeleton of *Coelophysis* suggests. Both images are approximately the same body length, but the toy has longer limbs and is generally more robust.
Pros

- **Jaw**: Articulated jaw. Moves accurately with respect to the rest of the skull for a dinosaur.
- **Beak**: Accurately presented beak. While one has never been recovered, it is suspected to have one due to its eating habits.
- **Head**: In respect to the rest of its body, the head is small which it is said to have. Scaling done well here.
- **Hidden Seams**: Has a creasing affect along the neck, which hides the head/neck connection seam.
- **Arms**: Anatomically correct. Only goes about 90 degrees than stops. Also has some great muscle features which shows the eminence strength it had.
- **Claws**: Great claws! Length proportional to body. Shows how massive claws were compared to the rest of its body.
- **Pelvis**: Has a protruding underside of the pelvis. In skeleton constructs and models all are showing a very distinctive pelvis which wasn't missed on this toy model.
Cons: Aesthetics

An annoying feature of the toy is the marks just below the knees—it looks like a poor job of joining the legs to the rest of the body.

I doubt the color scheme is very realistic—although the striping might be good, bright yellow and orange is not a terribly likely combination for a predator like *Coelophysis.*
**CON- MANUS AND PES (HANDS AND FEET)**

- *Diplodocus* had claws on one digit of the front limb.
  - The toy is missing this claw.
- This claw on the first digit is detached from the rest of the bones in the manus.
  - The toy features fused metatarsals and phalanges.


https://svpow.files.wordpress.com/2012/05/osborn1904-manus-acrum-caudals-fig1-manus-of-morosaurus-sp.jpeg

Student slide
Summary

• *Coelophysis* was a Triassic theropod dinosaur
• The *Coelophysis* toy by Geoworld® looks superficially accurate
• This is one of the few theropod models with 4 fingers (that is correct)
• The scale and proportions are not especially accurate
Summary (cont)

- Just to show that you can (and probably should) have more than 1 summary slide
### Grading the evaluations

#### Pros & cons

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<th>Half-$ed</th>
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<th>B is for bueno</th>
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#### Overall effort

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<th>6 points</th>
<th>Typical college student work</th>
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<th>Good work (top 20% of class)</th>
<th>8 points</th>
<th>Great work (top 10% of class)</th>
<th>9 points</th>
<th>Outstanding (top 5%)</th>
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#### Summary Slide(s)

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</table>

This is where a good project that spaced out a couple details makes up ground.
References


Holtz, T.R. Jr., 2002, Chasing *Tyrannosaurus* and *Deinonychus* around the tree of life: Classifying Dinosaurs. pp. 31-38 in Dinosaurs: The science behind the stories. AGU


# Grading nuts-and-bolts

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<th>Reasonably creative</th>
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<th>Distracting errors of italics/capitalization</th>
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### Final grade sheet

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<th>Reasonable writing but with typos and/or other issues</th>
<th>Clear writing, careful proofreading evident.</th>
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**Current grade in gradebook:** 92.05

**Grading student:** 6 out of 74

**Feedback comments:**

Only the second project I graded; seems pretty solid.
Above & Beyond

Mounts and Displays

Nagoya City Science Museum, from Gifu, Japan

Natural History Museum of Utah, Rio Tinto Center

The Wyoming Dinosaur Center

Australian Museum by Robert Jones

Dinosaur Museum in Blanding, UT
From the horses’ mouths

• **Needs Improvement:**
  • Slightly more forgiving with grading, effort should matter.
  • More project explanation.
  • A little more explanation of what he wants from projects not just requirements
  • More detail on assignments he wants completed maybe.
From the horses’ mouths

• **Things done well:**
  • Projects were very helpful and fun.
  • Visuals used, as well as projects given were extremely helpful.
  • Well organized and materials given/projects on ASU were very relevant and helpful.
  • I enjoyed all of the creative projects and ability to study the dinosaurs we had interest in.
  • I enjoyed the project greatly because I cannot express myself as well I would like to in a paper as I can in a creative project like this one.
Conclusions—the toy assignment helps

- ...demonstrate proficiency in acquiring, interpreting, and disseminating dinosaur knowledge.
- ...incorporate scientific, especially geological perspective into the educational experience at ASU.
- Get 250–300 credit hours/offering w/o lab.
- Maintain standards w/out reading 80+ papers.
- Force a few more folks to face the “e” word, deep time, and other scientific concepts.
- Students appear to enjoy it
Pros & Cons

• **Pros:**
  – Scalable
  – Difficult to plagiarize (& archivable)
  – Could go into “e-portfolio”
  – Requires students to learn presentation software
  – Educates students about *Coelophysis*

• **Cons**
  – “Plug-and-chug”/Rubric hurts grade flexibility
  – Does not evaluate writing *per se*
  – References—what to do?

• **Future directions:**
  – Toy manufacture date vs. apparent “scientific age” (e.g., 1980s toy, 1960s knowledge)
  – Dissemination?
Acknowledgments

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- The Adminisphere for putting GLY 1842 into a non-science theme.
- Many “A” students for providing project successes and sharing their work.
- Session organizers for including this whether or not it’s transformative.
Parasaurolophus in Left Lateral View

WORK IT TONY!
Parasaurolophus in Dorsal View

WEEEEEEERRRRRRKK!
Parasaurlophus in Anterior View

YES DINO! YAHHHSSS!